H2 Assessment of Infrared (IR) Thermography for the Estimation of Postmortem Interval in Rats

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After attending this presentation, attendees will better understand the potential utility of an additional tool for use in the estimation of the postmortem interval. Attendees will be able to better design additional research studies based on IR thermography for the estimation of the postmortem interval in various species.

This presentation will impact the forensic science community by contributing to the body of literature a controlled study on the use of IR thermography for the measurement of temperature decay in animal carcasses. Although results of this study demonstrated that the rat body size was not significantly large enough to allow for differences in internal versus external cooling rates, additional research can now be based on this model using animals of larger body size.

Experimental measurements of body temperature decay versus time for euthanized rats were performed using an IR camera in order to understand the usefulness of external temperature data in the estimation of postmortem interval. Experiments were performed in a fume hood to provide controlled conditions by limiting IR radiation contamination and minimizing the effect of stray air currents. Thermocouples were used to capture ambient air temperature, rat internal body temperature, and rat external body temperature as a function of time. Four adult female Sprague Dawley rats (*Rattus norvegicus*) of approximately 280g body weight were euthanized by carbon dioxide asphyxiation, immediately instrumented with thermocouples, placed in the fume hood, and the IR camera and temperature data logger were started. Probe thermocouples were placed in the rectum through the anus, in the liver through a stab incision in lateral body wall, and in the brain through a hole drilled in the calvarium. A surface thermocouple was also attached to the abdominal skin. An external thermocouple was placed approximately 0.5 meters from the rat to register ambient air temperature in the hood. All thermocouple signals were captured by a data logger at a rate of one sample per minute. An IR camera set up vertically above the rat acquired whole-body images at one-minute intervals corresponding to the thermocouple samples. Test duration was approximately 14 hours, which was sufficient time for the rat body to cool to room temperature. Images were calibrated by comparing the temperature of the surface thermocouple in the IR image to the temperature measured by the data logger.

An initial analysis of the rat body temperature decay was performed by modeling the rat body as a convectively cooled cylinder with a circumference that was the average of four rat thoracic/abdominal circumferences and a length that was the average of the four rat bodies from the base of the neck to the base of the tail. This analysis neglected the contribution of the head to the cooling rate. The convective cooling in the fume hood-controlled conditions was estimated to be primarily natural (free) convection, in which the localized heating of the air by the body resulted in density differences that made the hot air rise and circulate. The method of analysis of the rat body temperature decay with time can be determined by examining the Biot (*Bi*) number, defined as the rate of convection over the rate of conduction in the body, given the characteristic length (L_c) of the body calculated as volume/surface area. Results demonstrated that the rat body L_c is small enough that the *Bi* number is approximately 0.1, signifying that the core body temperature does not differ significantly from the external body temperature. This implies that the use of IR thermography as an additional data point in the improvement of postmortem interval estimates for a rat are not likely useful, since it does not provide unique information beyond that provided by internal thermocouples; however, for a body with a larger L_c, the additional information provided by IR thermography could be helpful in providing additional temperature decay data. As an example, L_c for a human body is approximately an order of magnitude larger than that of the rat, thus Bi approximates 1.0 so the surface temperature would appreciably differ from the core temperature during cooldown.

In conclusion, these data suggest that IR thermography may provide useful temperature decay data in animals of body size that approaches that of an average adult human.

Postmortem Interval, Infrared Thermography, Temperature

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